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0. Introduction

Yapese is an Austronesian language spoken in Yap, an island group in the West Caroline Islands of the West Pacific Ocean. One of the most striking facts about Yapese phonology is its syllable structure. All non-final syllables are CV or CVV. The only apparent instances of closed syllables are at the end of *all* words (CVC, CVVC).[2] We propose an underlying syllabic template of CV(V), and suggest that all word-final segments (which must be consonants) are licensed by extraprosodicity. We will review examples that apparently contradict the underlying template, but these apparent counter-examples of closed syllables in non-final position are, in our view, really examples of empty-headed syllables

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[1] This paper comes out of numerous discussions with G. L. Piggott. His imput is reflected throughout the work, although any shortcomings are entirely my own.

[2] We generally exclude clitics, borrowed words, and exclamations from our discussion.

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(syllables where the vowel -- the head of the syllable -- is null). Assuming the template, it therefore seems to be a requirement of all Yapese words that non-final syllables be open. It is clear from this restriction that consonant clusters at syllable edges are disallowed. Consonant clusters elsewhere (as a complex onset, or super-heavy coda) are prohibited as well.

This paper will explain the motivation for the syllable template proposed and further syllabic constraints and explore the manifestation of the consequences for syllable structure. First we will discuss the reasoning which would lead us to restrict the template to the one proposed. Then, we will look at how to account for final syllables, considering stress, apocope and compensatory lengthening. We will consider the problems caused by syncope. We will also examine morphological processes of affixation (which will introduce epenthesis), reduplication and compounding, concentrating on the instances which bring two consonants together, creating prohibited consonant clusters.

1. The Yapese Syllabic Template and Other Prosodic Restrictions

We follow Itô (1986) in defining our syllable restrictions in terms of a template. Following Itô (1989), we assume certain parameters that restrict the Yapese syllable to a CV(V) template. One parameter would exclude branching onsets and another would exclude codas (a coda filter). Let us first view the data which motivate the template chosen. We will also consider other prosodic restrictions in Yapese.

1.1. The Data

We will first consider some examples of Yapese words, exhibiting the syllable restrictions outlined above.[3]

(1)a.	*/cewa/*	*ce:w*	'type of net'
b.	*/cewa+gu/*	*cuwa:g*	'my net'

[3] Examples (1b) and (2b) exhibit "vowel reduction rules" (changing the /e/ to a /u/ in (1b), and to an /a/ in (2b)), described in detail by Jensen (1977). "They are called reduction rules because they reduce all eight short vowels to just three under the appropriate circumstances" (p. 79). Hung (1990) attributes the changes to [ATR] harmony. These vowel changes are not relevant to our discussion.

(2)a.	*/nifeŋi/*	*nife:ŋ*	'wind'
b.	*/nifeŋi+na/*	*nifaŋi:n*	'its wind'
(3)a.	*/luβa/*	*lu:β*	'breath'
b.	*/luβa+gu/*	*luβa:g*	'my breath' (p. 57,79)

All of the above examples manifest apocope and compensatory lengthening, discussed in sections 2.1 and 2.2. (Apocope and compensatory lengthening do not occur in all Yapese words, because some morphemes underlyingly end in a consonant, as in *pil* 'to break, shatter' (p. 44).)

1.2. The Minimal Onset Constraint

Onsets are obligatory in Yapese, and these onsets may only consist of one consonant. Yapese invokes a minimal onset constraint, which is a combination of extensions of Steriade's (1982) notion of a *universal core syllable* and Itô's (1989) *Onset Principle.*

Steriade recognizes CV as the core or unmarked syllable for all languages. As Yapese allows for long vowels, it does not restrict itself to licensing only the unmarked syllable. Yapese restricts itself to only part of this unmarked syllable, permitting only simple onsets. This minimal onset constraint clearly falls out from the concept of a core syllable. CV as the unmarked syllable entails that a single C is the unmarked onset (and a single V is the unmarked rhyme, which Yapese does not restrict itself to). Steriade's concept helps to ensure that the Yapese onset is non-branching, but we need Itô to ensure that we have an onset.

Itô's onset principle is stated as: Avoid $_{\sigma}[V$; and its purpose is to avoid onsetless syllables wherever possible. Stated in this form, the principle is useful for languages "in which surface onsetless syllables are allowed when no onset candidate is available (e.g. Japanese, Diola Fogny, Ponapean and English)" (p. 223). We need a stronger statement for Yapese (and the languages Itô mentions: Temiar, Axininca Campa, Arabic) which would rule out all onsetless syllables. Itô refers to this stronger version as the *Strict Onset Principle* which states that "onsetless syllables are impossible" (p. 223). We can interpret this formally as: $*\ _{\sigma}[V$. Itô mentions that this distinction between two types of languages is due to "a parameter setting for the *Onset Principle* where the values are 'relative' and 'absolute'" (p. 223).

Combining ideas from Steriade and Itô, we posit here an obligatory minimal onset constraint which Yapese employs: *all syllables contain a non-branching onset.* We assume that a version of this constraint would exist in a language where whenever onsets occurred they were simple, but onsets were not obligatory. This version would clearly be similar to the unrevised Itô onset principle along with our simple onset part of Steriade's core syllable.

1.3. Coda Filter

Word-initial and word-medial syllables in Yapese are licensed by prosodicity. The device that requires all syllable in non-final position to be open is a *coda filter*, a version of which is formulated by Itô (1986, 1989). Itô's coda filter is a parametric option that excludes codas that are singly linked to a place node, thereby permitting geminates, homorganic nasal-obstruent sequences, and other homorganic consonant clusters as coda-onset sequences -- as they are doubly place-linked --, but excluding all other codas. Yapese does not readily manifest such consonant sequences, but other languages which employ the coda filter do -- Ponapean, for instance.

As Itô discusses, Ponapean is a perfect candidate for her version of the coda filter. Ponapean does not allow consonant clusters generally, however, word-medially geminates and homorganic nasal-obstruent sequences do occur. It is clear that these consonant sequences are not instances of branching onsets, for these sequences occur very rarely word-initially (Rehg and Sohl (1981)). Since the sequences cannot be onsets, they must be, at least partially, codas. Since all other word-medial codas are excluded (a large class of consonants may occur word-finally, licensed by extraprosodicity), Ponapean needs a type of restriction that refers to the unique nature of geminates and homorganic nasal-obstruent sequences. Itô's coda filter does just that, by excluding only *singly* place-linked codas. This allows the first segment of the consonant sequence to be a coda, and it is not ruled out by the coda filter as it shares a place node with the following onset.

Itô's coda filter assumes an ability to see to where the coda is linked and to see if there is an additional link to that place node. Perhaps the only difference for Yapese is that Yapese does not care if there is one link or two to the place node; even placeless segments are not permitted. We can assume that Yapese employs a more rigid coda filter than the one originally proposed by Itô, in which all codas are prohibited. The Yapese coda filter is formulated to exclude all syllables with final consonants: $* \, C]_{\sigma}$. It does not refer to linkings to a place node as the Itô filter does, for Yapese does not allow codas which are homorganic with the following onset (which are doubly place-linked), nor placeless segments of any kind.

1.4. The Minimal Word Constraint

McCarthy and Prince (1990) discuss Yapese vocatives in regard to a minimal word constraint. They suggest that the truncation found in these vocatives is the result of mapping to a minimal word template.

	Full Noun	Vocative	
(4)	*luʔag*	*luʔ*	
(5)	*βaya:d*	*βay*	
(6)	*maŋɛ:fɛ:l*	*maŋ*	(Jensen, p. 101,114,115)

A similar process has been found in other languages, such as Central Alaskan Yup'ik Eskimo, Japanese and English. McCarthy and Prince state that the minimal word in Yapese is bimoraic. We adopt this suggestion, and assume a Yapese minimal word constraint, restricting all Yapese words to minimally two moras.

There is a clear relationship between syllabification and the minimal word constraint. In cases of words like *pil* ('to break, shatter') and *βil* ('to grind, smash or crack'), the final consonants must fulfill their role in satisfying the minimal word constraint. These final consonants are assigned a mora. They are not extraprosodic. These consonants are forced to be moraic as syllabification compels them to fulfill the minimal word template. These consonants are not inherently moraic, and they would therefore not be moraic under suffixation. Recall this is a condition on words, not on syllables. The minimal word constraint is a template which we are imposing on representations and which must be satisfied.

The McCarthy and Prince arguments give us evidence that Yapese has a minimal word constraint. In examples (1a) and (3a)

(1) a.	*/cewa/*	*ce:w*	'type of net'
(3) a.	*/luβa/*	*lu:β*	'breath'

we see how the minimal word template can be filled in Yapese by a single bimoraic syllable. Apocope applies in these examples with two monomoraic syllables underlying. The floating mora, resulting from the apocope, transfers over to the preceding syllable. (This process of apocope in Yapese is discussed in detail in section 2.2.)

We find a situation in Lardil (Hale, 1973) which contrasts with Yapese. In Lardil, as well, apocope regularly occurs. However, in Lardil, apocope ceases to apply when the result will be a monosyllabic word.

Lardil enforces a minimal word constraint which is manifested differently than the Yapese constraint. Perhaps mora adjunction is missing in Lardil. A minimal bimoraic word can either be two (monomoraic) syllables or one heavy syllable.

Although Ponapean and Yapese have the same minimal word template, they satisfy the template differently. In Yapese, the minimal word constraint overrides extraprosodicity and gives final consonants a mora, whereas Ponapean appears to maintain extraprosodicity. Below, we see the same bimoraic template with different outcomes for the equivalent segmental string of *pil* in the two languages:

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(7) Yapese                  (8) Ponapean
       σ                           σ
     /\ \                        /\\\
    / μ μ                       / μμ \
   /   \ \                     /   V   \
  p     i l --> [pil]         p    i    l --> [piil]
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In discussing the difference between the two languages, we ask ourselves the question: what determines if a consonant is extraprosodic or not in the two languages? In all instances, other than monosyllabic words, the determination is the same. It is therefore directionality that allows us to get the appearance of precedence of the minimal word constraint over extraprosodicity in Yapese, and extraprosodicity maintenance for Ponapean. We conclude from examples (7) and (8) that syllabification in Yapese occurs left-to-right, and syllabification in Ponapean occurs right-to-left.

Prince (1983) states that "extrametricality cannot function to create an ill-formed representation" (p. 80). We follow Prince in assuming that extraprosodicity cannot apply to block the satisfaction of well-formed structures. In this instance the well-formed structure is the minimal word template. We must always have obligatory satisfaction of the minimal word template. In syllabifying (7) (*pil* to the minimal word template) left-to-right for Yapese, the /p/ maps to the onset position, the /i/ fills the left-most mora, leaving the other mora, and the /l/ maps to this empty mora (where it ordinarily could not attach), in order to ensure satisfaction of the minimal word template. In syllabifying (8) right-to-left for Ponapean, the /l/, as it is word-final becomes extraprosodic. We assume that it does not know that there are many moras needing to be syllabified. We speculate that the /l/ is blind to the structure that follows it. After the /l/ is no longer available to take one of the moras, the /i/ maps to them both, creating the long vowel in example (8). The /p/ must map to the onset position.

The Yapese minimal word constraint accounts for the occurrence of a syllable type in monosyllabic words that is not otherwise attested. True CVC syllables do not occur anywhere except in monosyllabic words, exactly as predicted by the minimal word constraint. In any other context, a syllable of type CVC would violate Yapese syllable restrictions, as it would not conform to the CV(V) template.

If we allow the final consonant in a word like *pil* to be moraic, we then have the problem of what excludes the final consonant in (3a) from taking the mora, rather than the preceding vowel, as in all bisyllabic words which become monosyllabic in Yapese by apocope. We must assume for compensatory lengthening and apocope (described in more detail in section 2.2) that the floating mora cannot dock on the consonant. This would remain a problem for Hayes (1989), because he assumes that the syllable structure is destroyed during apocope. If the structure is destroyed, we cannot stop the mora from mapping to the consonant, as the consonant would no longer be syllabified. However, if we assume that the structure is preserved, as in Piggott (1991a), the solution is clear. Piggott proposes that when apocope applies, syllable structure is maintained: the deletion of the vowel simply creates an empty-headed syllable. (The onset of a word-final empty-headed syllable is exactly the structure Piggott proposes for extrametrical segments.) Following this assumption of maintenance of structure, the floating mora cannot attach to the final consonant as the final consonant is already syllabified in an onset position, and as we mentioned above, moras cannot attach to onsets.

1.5. Summary

We cannot assume that the syllable restrictions occur in the Yapese data as an accident. We account for the restrictions by positing an underlying template of CV(V). This is a manifestation of a Yapese minimal onset constraint and a coda filter. In addition to the satisfaction of this template, syllable structure is partially driven by a requirement for a well-formed minimal word. It is clear now why all non-final syllables appear open with a single onset, but that still leaves the problem of why word-final syllables appear to be closed.

2. Word-Final Syllables

2.1. Extraprosodicity

Itô's (1989) version of extrametricality is to assign extrametrical status to word-edge segments that cannot otherwise be syllabified. Extraprosodicity is a parametric option. She realizes that extraprosodicity makes it unnecessary to postulate syllable-types that are restricted to occurring only at word-edges. Extraprosodicity in the manner assumed in this paper is explored by Hayes (1981, 1982), Piggott (1983, 1991a), Itô (1986), Clements and Keyser (1983), and Steriade (1982).

Since the only instances of apparent codas are at the edge of words in Yapese, extraprosodicity seems a obvious solution. Extraprosodicity has the ability to license segments at word edges that are not otherwise licensed by syllabification. It is a parametric option which Yapese employs. Some languages which have material at the edge of a word that cannot be licensed by prosodicity, leave this material unrealized. Following the Itô (1986) assumption that *all segments must be licensed in order to be realized*, extraprosodicity functions as a licensing mechanism, just like syllabification, in order to ensure phonetic realization. Yapese not only allows for the rightmost segment of words to be licensed by extraprosodicity, but requires it. As well, Yapese further restricts extraprosodicity to apply only to consonants. Some languages, Ponapean for instance, employ extraprosodicity, but also allow prosodicity (syllabification) to license word-edges. The difference between the Ponapean option and the Yapese is phonetically realized in that all Yapese words end in consonants, whereas Ponapean allows for words to end in both consonants and vowels.

In regard to theories of extraprosodicity, we most closely follow Itô (1986), as described above, and Piggott (1991a). Piggott assumes that an extraprosodic consonant at the right-edge of a word is the onset of an empty-headed syllable. He also explains that extraprosodicity is a licensing mechanism for word-edges, which we assumed above.

2.2. Extraprosodicity (cont.), Apocope and Compensatory Lengthening

The inter-related issues of extraprosodicity and apocope in Yapese, exhibited above in examples (1) through (3), are dealt with extensively in Piggott (1991a). We will generally assume Piggott's analysis, crucially recognizing the mandatory licensing of the right edge of words in Yapese by extraprosodicity, as discussed above. Jensen (1977) descriptively correlates the processes of apocope and compensatory lengthening: "when a short vowel is written at the end of a word do not pronounce the short vowel, but pronounce the vowel immediately before it as long." (p. 59)

Hung (1990) describes apocope and compensatory lengthening in Yapese. She assumes that when the final vowel is deleted, the entire syllable structure disappears, as the head of the syllable no longer exists. This leaves behind the mora from the final vowel and the consonant, which was the onset of the syllable, and is now floating. She then assumes the previous vowel spreads its properties to the floating mora, and the mora attaches to the new syllable. The final step is resyllabification in which in floating consonant adjoins to the right-edge of the syllable. This adjunction is not inconsistent with extraprosodicity for Hung. She assumes that the final consonant is extrasyllabic, and that is why it cannot fill the empty mora, as there are no CVC syllables in Yapese.

Piggott (1991a) also similarly explains compensatory lengthening as triggered by the apocope. The preceding vowel is lengthened, when apocope occurs. Piggott explains this in terms of the transfer of a floating mora, in this way, very similar to Hung. Piggott differs from Hung in that for Piggott syllable structure is preserved when apocope applies. The apocope is triggered by the Yapese constraint that word-final elements be licensed by extraprosodicity, and we propose that in Yapese only consonants can be extraprosodic. (This is a simplification of Piggott's account of extraprosodicity for Yapese, which involves an empty-headed syllable at the right-edge, mentioned briefly above.) It is noteworthy that both apocope and compensatory lengthening are *triggered* -- apocope triggered by a right-edge consonant extraprosodicity requirement, and compensatory lengthening triggered by the floating mora from the apocope -- and not randomly language specific, and therefore stipulated. We are thereby predicting that occurrence of apocope is entailed by a constraint on word-edges, and that compensatory lengthening is then precipitated by apocope. Importantly, what is language specific to Yapese is the word-edge constraint that the rightmost segment of every word be licensed by extraprosodicity, and that only consonants may be extraprosodic. This triggers apocope and compensatory lengthening. Apocope is strictly phonologically driven, as it is necessary in order to conform to licensing restrictions in Yapese.

2.3. Stress

It is a standard assumption in many prominent theories of stress assignment (including Hayes (1981) and (1982), Prince (1983), Hammond (1986), Halle and Vergnaud (1987)) that stress always applies in relationship to word-edges. We assume that main stress cannot apply to a syllable that is more than three syllables away from either the left or right edge. This follows from allowing for extrametricality and then a binary branching foot (or the equivalent) allowing its head to be on the side furthest from the word-edge. In languages where epenthetic vowels are not visible to stress assignment, main stress can fall further away from the word-edge, as in Mohawk.

In Yapese stress applies in relation to the right-edge, therefore a brief overview of Yapese stress assignment is necessary. Primary stress in Yapese is assigned to the final syllable of each word, except in the instance where the penultimate syllable is long and the final syllable is short, in which case the penult receives main stress. Many words have secondary stress as well, and some words have more than one secondary stress, but the placement of the secondary stresses is not well documented. We will then focus our discussion on main stress. It is a simple stress system which can easily be explained in many frameworks. It is a quantity sensitive system, which constructs right-headed feet. The examples below exhibit the four possible permutations and combinations between long and short syllables in the penult and final syllables.[4]

			penult	final	stress
(9)	*mʌ:rʌ́:s*	'to press'	long	long	final
(10)	*ciβíy*	'to lift'	short	short	final
(11)	*m'agpá:?*	'wedding'	short	long	final
(12)	*sá:lap*	'expert'	long	short	penult
				(p. 93)	

Stress applies after apocope and compensatory lengthening.

3. Syncope

Although a coda filter is in effect in Yapese, as well as a minimal onset constraint (restricting obligatory onsets to a single position), allowing for the maximal prosodically licensed syllable in Yapese to be CVV, we do see consonant clusters in phonetic (surface) forms, when syncope applies. Jensen (1977) presents the Yapese syncope rule as follows: "drop a short vowel which has a syllable on its left and another syllable on its right"

[4] The /m'/ in example (11) represents a glottalized /m/.

(p. 59). We see that this description is valid for the data below.[5] The vowel the second from the right is syncopated.

(13)a.	*/ʔamiθu/*	*ʔami:θ*	'pain'
b.	*/ʔamiθu+gu/*	*ʔamθu:g*	'my pain'
c.	*/ʔamiθu+mu/*	*ʔamθu:m*	'your pain'
d.	*/ʔamiθu+na/*	*ʔamθu:n*	'his pain'
(14)	*/luβa+ðaðu/*	*luβðä:ð*	'our (inclusive) breath'

(p. 57,58,60,145)

There is no syncope in example (13a), as apocope applies before syncope (see section 3.2).

Although Jensen does not state whether the syncope rule is obligatory or not, we find some surface forms which seem to imply that it not.[6]

(15)	*luk'ane:ni:w*	'coconut palm heart'
(16)	*leʔeβʷʌʔ*	'green beetle nut leaf'

(p. 33,35 in dictionary)

According to the rule, as stated by Jensen, we would predict that for (15) the /a/ would delete by syncope. For (16), we would predict that the second /e/ would delete by syncope. These prediction are based on the fact that each of those vowels is short and has a syllable to its left and a syllable to its right. Since what the syncope rule predicts does not occur in these examples, we conclude that the rule is perhaps optional.

3.1. Floating Mora?

As a result of the syncope, we might assume that there is a floating mora, just as we do for apocope. Each process involves the deletion of a

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[5] Example (14) undergoes an "a-lightening" rule, described by Jensen (where the /a/ changes to an /ä/), which is not relevant to our discussion. This is another instance of the Hung proposed [ATR] harmony.

[6] In example (15), /k'/ denotes a glottalized /k/. The /βʷ/ in example (16) represents a labialized /β/.

vowel, and for apocope we assume that the mora which was associated with the deleted vowel is left behind. If we assumed that compensatory lengthening were triggered in order to realize this floating mora, and if we allowed compensatory lengthening to occur word-medially, triggered by syncope, we would predict the wrong results. (The corresponding examples in (13) are reproduced here for ease of reference.)

(13)b. /*ʔamiθu+gu*/	*ʔamθu:g*	(17) a.	* *ʔa:mθu:g*
c. /*ʔamiθu+mu*/	*ʔamθu:m*	b.	* *ʔa:mθu:m*
d. /*ʔamiθu+na*/	*ʔamθu:n*	c.	* *ʔa:mθu:n*

This incorrect prediction is prompted by the potential parallel situation of the apocope-triggered compensatory lengthening. Here with syncope we cannot follow the same reasoning of the transfer of a floating mora. What restricts this behavior to apply only at word edges? Hayes (1989) and Piggott (1991a) submit that an adjunction process licenses the floating mora. If we assume that adjunction can only occur at word-edges, it follows that compensatory lengthening only occurs at word-edges. We see evidence for this in compounding (section 5.2), when there is no compensatory lengthening, because the floating mora is no longer at the edge, and the vowel deletion is no longer apocope, but syncope.

Another possible solution to why syncope does not trigger compensatory lengthening is to assume that syncope, unlike apocope, has no phonological trigger, but is triggered by speech rate at the phonetic level. Perhaps Yapese speakers drop word-medial short vowels when they are speaking quickly. This is consistent with the hypothesis that syncope is an optional process. Syncope is optional in Ojibwa (Piggott, 1991b). Lacking Yapese informants, we gain other evidence which supports this claim from Ojibwa. When Ojibwa speakers are asked to speak slowly, they reinsert syncopated vowels, but never apocopated vowels. We could then assume that in languages where there is compensatory lengthening word-medially (if such languages exist), syncope is driven by something other than speech rate.

3.2. Rule Ordering

Regarding the ordering between compensatory lengthening and syncope, the process of apocope, which directly triggers compensatory lengthening, must apply before the syncope rule. There is interaction between syncope and compensatory lengthening. If syncope were to occur first, in a three-syllable word, the vowel of the penultimate syllable (the middle vowel) would be the vowel to undergo syncope, and the first vowel would then be lengthened by compensatory lengthening after apocope applied. Since it is the penultimate vowel which is lengthened, this vowel needs to remain, and cannot undergo syncope. The following example illustrates this.

(18) */yaŋare/* *yaŋa:r* * *ya:ŋr* 'age' (p. 77)

This ordering is consistent with the hypothesis that apocope is a phonological process and syncope is a phonetic one. If syncope occurs at the level of phonetic representation, then it of course must occur after apocope.

3.3. Directionality

The syncope rule as stated by Jensen raises the question: which direction are we starting from? If we have a nine syllable word, we assume that all word-medial vowels are not deleted, for how could we possibly pronounce such a word? So, we would speculate perhaps that the second, fourth, sixth syllables, and so on would undergo syncope. But what about if we counted the other way? Looking at some data should clear up this point. Example (14) may superficially indicate that the directionality of the syncope rule is left-to-right, as the second vowel (from the left) is syncopated, in an underlyingly four syllable word. However, we must recall that we just concluded that the apocope rule must apply before the syncope rule, and therefore we still cannot determine the directionality. When we apply syncope starting from either edge in example (14), after apocope and compensatory lengthening have applied, the same vowel is targeted -- as the word then consists of only three syllables, and then only the middle vowel can be affected --, following Jensen's description of the syncope rule.

In trying to find an example which can determine the direction of application, we come across one example which seems to imply that directionality is variable.

(19)a. *palaβθir* 'old person'
b. *pilβiθir* 'old person' (p. 108)

We can assume that the underlying structure of the above words is: */p+laβiθir/*. (The root meaning 'old', occurs phonetically as *laβθir*, when it stands on its own, as it is the only allowable form, following the syncope rule.) The alternation of the initial vowel in the first syllable in example

(19) above is due to the fact that this vowel is an epenthetic vowel, which is inserted between the /p/ and the /l/, which copies the melody of the vowel following it (in the case of prefixation). When the vowel immediately following the epenthetic vowel changes -- as we have here as a result or differently-directioned syncope -- the epenthetic vowel changes its quality. This process is discussed in section (4.3.2).

Example (19a) implies that the direction of syncope application is right-to-left. In this example, the vowel in between the /β/ and the /θ/ is deleted, and if we are counting right-to-left, it would be the first vowel we would come across that has a syllable on its left and a syllable on its right. Example (19b) implies that the direction of syncope application is left-to-right. In this example, the vowel in between the /l/ and the /β/ is deleted, and if we were counting left-to-right, it would be the first vowel we would come across with a syllable on its left and a syllable on its right.

Example (19) also strengthens the claim that syncope is a speech rate phenomenon, if we assume that phonetic processes are more likely to be optional and variable. Syncope would therefore be less rigid in regard to directionality than a phonologically triggered process.

3.4. Empty-Headed Status

The syncope process that we assume involves the creation of an empty-headed syllable. We base this assumption on Piggott's (1991a) discussion of apocope. When the vowel is deleted by syncope, the syllable structure is not deleted, and the head position is filled by a null element. This is an extension of Piggott, who posits empty-headed syllables only word-finally. Our position here is somewhat similar to Kaye (1990) who posits empty-headed syllables word-medially. Kaye uses empty-headed syllables to license 'codas'.

Does the above syncope rule, as stated by Jensen, take into account the new state of a syllable, now empty-headed, by syncope? Our assumption here is that, when syncope applies to a syllable, that syllable becomes empty-headed. If the syncope rule does not take this possible syllable status into account, the rule would simply reapply to syllables with single vowels, until we had only a word-medial string of consonants without vowels in between them, making the string unpronounceable. We therefore must assume that the syncope rule, as stated by Jensen, with added directionality (as of yet, undetermined), must only refer to syllables with non-null heads. The restatement of the descriptive Jensen rule to include this restriction would be as follows: drop a short vowel which has a syllable with a phonetic (non-null) head on its left and another syllable with a phonetic head on its right.

3.5. Effects on Syllable Structure

There are obviously some complicated specifics surrounding this syncope rule. We must consider how syncope interacts with syllable structure. When the correct environmental conditions for syncope application are met, syncope applies, creating an empty-headed syllable. There is no delinking of the association line involved. The segment itself is deleted, and a null (0) element is inserted to fill the position, in order to maintain the proper syllable structure restrictions. If the association line were delinked, the syllable structure would be affected, as the in tact association line is necessary for a properly-formed syllable. We maintain the proper syllable structure only by deleting the segment and replacing it with a null element. Although we do not have a phonological principle triggering syncope, as we do for apocope, we still have a defined context for application, as well as a maintenance of syllable structure. We claim that syncope has no affect on syllable structure, but only on content. The underlying syllable structure, even after syncope has applied, remains within the constraints of Yapese syllable structure, despite the surface form indicating otherwise. The new empty-headed syllable will be a CV syllable, where the V is filled by a null element.

4. Affixation and Epenthesis

The general lack of consonant clusters invites the question: what happens during prefixation when the prefix ends in a consonant and the root begins with one, or during suffixation when the stem ends in a consonant and the suffix begins with one, or during reduplication or compounding, when roots meet and two consonants come together? As affixation answers this question differently than does reduplication and compounding, we will deal with these phenomena separately.

4.1. Prefixation

The great majority of prefixes end in vowels, for example the derivational prefix */p'e:-/*[7], which designates 'locative'. See below.

(20) */nifiy/* 'fire' *p'e:nfiy* 'cook house' (p. 104)

[7] /p'/ denotes a glottalized /p/.

Example (20) undergoes the same syncope rule as examples (13) and (14) discussed above.

Yapese syllable restrictions predict that almost all prefixes end in vowels. These prefixes which end in vowels are not interesting in regards to the problem of the resolution of consonant clusters. However, there is at least one prefix in Yapese */p-/* (a derivational prefix, meaning 'human') which can perhaps shed some light on this problem.

When this prefix is attached to a stem, epenthesis is triggered, and a vowel is inserted identical to the following vowel.[8]

(21) */p+milŋa:y/* *pimilŋa:y* 'low caste person; slave' (p. 108)

This process of epenthesis is discussed further in section 4.3. It is important to note here that when prohibited consonant clusters occur during prefixation, the offending structure is remedied by epenthesis.

4.2 Suffixation

The resolution of consonant clusters created by suffixation is evident in an example where the root underlyingly ends in a consonant and the suffix begins with a consonant. The below example involves the transitive suffix */-y/*, with the verb */βug/* 'to bend'.[9]

(22) */βug+y/* *βuguy* 'to bend something' (p. 83,128)

This example inserts a /u/ in between the /g/ and the /y/. This /u/ is not part of an underlying stem, but is inserted as a copy of the preceding vowel. This is another instance of epenthesis. We are developing a clearer and more consistent picture of epenthesis, as we see it mending prohibited sequences in both prefixation and suffixation.

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[8] The deletion of a vowel between the /l/ and the /ŋ/, is the result of right-to-left syncope.

[9] We know that the underlying form of the suffix is */y/* and not */yV/* as it does not trigger compensatory lengthening: the form */ʔaru/* 'murky, of water' with this transitive suffix added becomes */ʔaruy/* 'to stir' and not * */ʔaru:y/* (p. 128).

4.3. Epenthesis

As we have already seen in examples (19), (21), and (22), Yapese exhibits a process of epenthesis which breaks up consonant clusters. We see local harmony when we have epenthesis, for the vowel that is inserted -- the epenthetic vowel -- is a copy of the *preceding* vowel. When there is no preceding vowel in the word (when the vowel is inserted after the initial consonant) the *following* vowel is copied, as we saw above in the prefixation examples.

4.3.1. Triggering Epenthesis

This epenthesis appears to be result of syllabification. Yapese employs the parametric option: *all segments must be licensed* (Itô, 1986). This is what triggers epenthesis. We have no consonant deletion in Yapese. Prosodicity or syllabification forces all segments into a syllable, triggering epenthesis where required. In order to properly syllabify every consonant, the ones which do not have a vowel immediately following them, will still be part of a syllable -- created during syllabification --, and this syllable will have a vowel position that needs to be filled. These positions are partly created by the need to syllabify every segment and partly by the assumed minimal template of CV. This vowel position is realized, as the preceding vowel spreads its features to it.

4.3.2 Vowel Harmony

It is possible to account for the vowel harmony that we see in epenthesis by assuming that the consonants and vowels are on separate tiers. This assumption is necessary in order to allow for the spreading of vowel features across consonants without crossing association lines. When an epenthetic vowel is inserted, as described above, it is simply a position, lacking content, and so the preceding vowel spreads its features to it, so that it can be realized. We see that the harmony rule applies bidirectionally, and the rule seems to be spread adjacent stem vowel. However, since we can observe that, whenever possible, the epenthetic vowel is a copy of the vowel to the left (the preceding vowel), we must assume that the unmarked direction for spreading in Yapese is left-to-right. On the other hand, for prefixation, since there is no choice of which vowel to copy, because there is no preceding vowel, we assume marked right-to-left spreading. The epenthetic vowel's content, in these prefixation examples, cannot otherwise be filled, given the constraint that vowels do not spread across word boundaries.

In order to allow for marked spreading, we must assume there is no default epenthetic vowel. If Yapese had a default epenthetic vowel, that default vowel would occur in the prefixation examples where instead we see instances of a copy of the following vowel, indicating marked right-to-left spreading. However, vowel copy is perhaps just another default option.

4.3.3. Stress

It is useful to consider how stress applies to epenthetic vowels. See the examples below.

(23) */ciβ+y/* *ciβíy* 'to lift something'
(24) */paʔ+gu/* *paʔág* 'my hand' (p. 42,93,100)

In both of the above examples the epenthetic vowel receives stress. We see the stressed epenthetic vowel in (23) between the /β/ and the /y/, and between the /ʔ/ and the /g/ in (24). Yapese clearly treats epenthetic vowels the same as full vowels in regards to stress. This is not the case for many languages. Indonesian, for instance, completely skips over epenthetic vowels when assigning stress (Cohn (1989)). We might then assume that in Yapese stress assignment must take place after epenthesis, so that the epenthetic vowels will be visible to stress assignment. However, we will propose that epenthesis involves simply the interpretation of a position, which is already present and which already has a mora. In that case, epenthesis could occur after stress assignment, since the epenthetic vowel's mora would be present. Then the epenthetic vowels would be included in determining stress assignment because their positions (and moras) exist as an inherent part of the syllable structure.

Examples (23) and (24) differ in a very interesting way. In example (23) the epenthesis is straightforward. We might assume from this example that the syllabic template which causes the epenthesis already has a mora attached to it to ensure that stress assignment takes the epenthetic vowel into account. However, the issue becomes more complicated when we consider example (24) as well. The suffix /*-gu*/ in example (24) ends in a vowel, unlike in example (23). This final vowel is deleted by apocope. Normally apocope triggers compensatory lengthening. However, there is no compensatory lengthening, because the vowel that would be lengthened is an epenthetic vowel. What exactly causes the epenthetic vowel to remain short? Although it would certainly be odd to have a long epenthetic vowel -- as generally epenthetic vowels are inserted simply to hold a position, and often do not have any moras at all -- , we might assume that the position for epenthesis carries a mora in order to be visible to stress assignment, not just for this example, but more essentially for (23). Therefore, when the final /u/ in (24) is deleted by apocope, we would generally assume that the now floating mora would dock onto the previous vowel position, making the epenthetic vowel, which already had one mora, bimoraic.

Clearly this cannot be the correct characterization because the epenthetic vowel in (24) is not long. Recall that epenthetic vowels get their phonetic properties from the spreading of features from the preceding vowel. Perhaps there is some restriction in Yapese on long distance spreading, for the features would need to spread to the new mora, or a restriction on too many non-single links. The below structure of an epenthetic vowel which has been spread features and been transferred a mora certainly does look complicated.

```
(25) p   ?   g          p   ?   g
     |   |   |          |   |   |
     C V C V C V  -->   C V C V C V̸
       |   |   |          |   | \
       μ   μ   μ          μ   μ   μ
       |       |          |  /  /
       a       u          a
```

There is a more attractive solution which allows a mora to be present so that the vowel in (23) can receive stress, but which also maintains the shortness of the final vowel in (24). We suppose that the floating mora cannot adjoin to a syllable that has no phonetic content. Example (24) would then not involve adjunction of the floating mora from the apocope. We would also assume that the syllable template which triggers epenthesis carries a mora. We can actually assume that this template for examples (23) and (24) is the minimal word template. The mora associated with the epenthetic vowel in both (23) and (24) would have resulted from the template. The need to satisfy this template is what triggered the epenthesis, as generally syllabification triggers epenthesis.

Our assumption is that the syllable template includes moras We propose that the mora associated to the vowel position of a syllable template is obligatory. We assume that if a prosodic unit is a syllable, it must have a mora, in Yapese.

5. Reduplication and Compounding

When we turn our attention to reduplication and compounding, we no longer see instances of epenthesis to reconcile ill-formed consonant clusters. At first glance, the newly formed consonant clusters remaining in the surface forms, appear to violate syllable restrictions.

5.1. Reduplication

The following forms exhibit the most common type of reduplication, involving the repetition of the initial CVC sequence (as described by Jensen p. 110).

(26) */ŋo:c/*	*ŋocŋo:c*	'short' (inchoative to attributive)
(27) */ʔa:r/*	*ʔarʔa:r*	'murky'
(28) */pe:le:g/*	*pelpe:le:g*	'to hide repeatedly' (p. 101,110)

It is necessary that the reduplicative affix conform to one of the prosodic types. We therefore postulate that the reduplicative affix here is the minimal word, a bimoraic foot, and not a CVC template as Jensen implies.

5.1.1. An Explanation Using Syncope

Although these examples appear to have consonants coming together creating prohibited consonant clusters, we find it beneficial to propose that the underlying representations given in the above examples are incorrect. Let us first consider (26) and (27). We know that the underlying form of (27) is */ʔaru/*. As mentioned above, we see the /u/ when we add the transitive suffix */-y/*: the resulting form is *ʔaruy* 'to stir'. This /u/ appearing with the suffix must be an underlying vowel and part of the root; it cannot be an epenthetic vowel, as epenthetic vowels are always copies of adjacent vowels. Although we do not have direct evidence for the underlying form of (26), we posit */ŋocV/* (where V represents some specific underlying vowel). Then notice how the surface forms in these examples, where we see the consonant clusters, look very similar to the syncope examples (13) and (14). The surface consonant clusters here would ensue from syncope. The underlying word-final vowel of the first word would be syncopated. The final syllable vowel length would be the result of apocope and compensatory lengthening. This would clearly account for why the vowel in the first syllable is short. This vowel appeared long in the underlying examples given in (26) and (27), because when the vowel was penultimate, the vowel was lengthened by compensatory lengthening, which in Yapese only occurs at the right-edge of words.

Some complications arise when we look at example (28). As the entire word is not reduplicated, because the word in (28) has more syllables than the other forms, we need another solution. The appearance of shortening of the first vowel from its unreduplicated form to its reduplicated form cannot be due to a lack of compensatory lengthening in the reduplicated form, because there are more syllables and the first vowel is not the final vowel (which would be the vowel to undergo compensatory lengthening) as it is in the other examples. There is no way to tell that this example does not have the minimal word template as a reduplicative affix, with syncope applying to obscure the second vowel which would house the second mora. The first templatic mora would pick up the /e/ from the first syllable, and the second mora would pick up the /e/ from the second syllable. We would then be assuming that syncope applies left-to-right (deleting the second /e/ that was picked up), contrary to what we assumed for (21), but not inconsistent with our initial claim that the directionality of syncope is variable, illustrated by example (19).[10]

5.1.2. Remaining Problems

Most reduplicative forms can be explained by the reasoning above. Some cases would involve a different prosodic template for the affix. However, there are a few examples that seem to have no clear solution.

For the reduplication example in (29), we still have a problem.

(29) */ro:w/ ro:wro:w* 'red' (p. 110)

If we assume that the template is the minimal word or even more simply a bimoraic foot, we cannot not stop the first /w/ from mapping to the mora, which would cause the first vowel to appear short. In fulfilling the minimal

[10] Another alternative for all of the above examples, that does not involve syncope, is that the reduplicative template is the minimal word template, and the last mora is prelinked to a null element, so that nothing can attach to it. We would certainly need a lot more evidence to support this claim. Both solutions will maintain the syllable structure restrictions of Yapese.

word template in Yapese, the final consonant regularly does map to the mora, as in example (7). The mapping of a consonant to a moraic position in the minimal word template is only arrested when there is a floating mora which is the result of apocope. We assumed that the floating mora could not dock onto a consonant, as the consonant is already syllabified. This entire situation is described in more detail above in section 1.4. For example (29), the non-final /w/ will not be organized in to a syllable, and would therefore be available to map to the mora, which must map to the vowel, as the vowel appears long at the phonetic level. We leave this problem unanswered.

5.2. Compounding

As compounding involves the joining of two words, and all words in Yapese begin with consonants and end with consonants, compounding is an obvious place to look for the resolution of consonant clusters. Consider the following examples.[11]

(30)	*/m'a:g+pa:?/*	'tie' + 'his hand'	
	m'agpa:?	'wedding'	
(31)	*/pa:g+tali:n/*	'to let go of' + 'its equipment'	
	pagtali:n	'to forget'	(p. 101,122)

5.2.1. An Explanation Using Syncope

In many ways accounting for the compounded forms is very similar to accounting for the reduplicative forms. However, compounds do not involve mapping to a template. It is necessary in compounding to discuss each part of the compound as a separate word, and then together in the compound. Jensen unfortunately does not provide the data for the underlying forms of each of the words in isolation. The underlying forms given for (30) and (31) are each word in isolation at the phonetic level. However, if we posit the underlying form of the roots in isolation for (30) to be */m'agV/* and */pa?V/*, and for (31) to be */pagV/* and */talinV/* (where V represents some specific underlying vowel, not necessarily the same for each word), the consonant clusters would be the result of syncope, just like in the above reduplication examples. The unknown hypothetical vowel of the first word would be deleted by syncope. The surface word-final vowel

[11] The /m'/ in example (30) represents a glottalized /m/.

would get its length from compensatory lengthening from the apocopated underlying word-final vowel. It is also possible that underlyingly the surface final vowel was already bimoraic, and therefore either was unaffected by apocope (see section 5.2.2) or no apocope took place, for underlyingly there was no word-final vowel (contrary to the form we posited above).

Despite the many syllables in (31), which caused problems in example (28), we are lead to a clear solution. The final vowel (this unknown hypothetical vowel) when compounded is deleted by left-to-right syncope.

5.2.2. Remaining Problems

For other compounding examples we do not immediately see a clear option of how to account for them.

(32) */fa:k+l'u:θ/* 'offspring of' + 'rotten wood'
fa:kl'u:θ 'worm' (p. 123)

If we suppose that the stems involve long vowels, we do not necessarily have a problem. Following Piggott (1991a), we know that although apocope will always apply, when the proper conditions are met, compensatory lengthening (the adjunction of a floating mora) "applies only if the penultimate syllable does not have its maximal weight (i.e. bimoraic)" (p. 15). We can therefore conclude that for example (32), there still may be a final vowel that was deleted by apocope, and a vowel underlyingly after the /k/ which was deleted by syncope. The rightmost word is never a problem for these forms. We posit that the underlying form for the first word is */fa:kV/*.

6. Conclusion

In this paper we have explored Yapese syllable structure. We have explained what forces such firm restrictions on Yapese syllable structure, what determines these restrictions. We have come to realize that syllabification in Yapese is not simply driven by restrictions on syllable structure, but as well by a condition on words: the minimal word constraint. We have also examined the processes which maintain and obscure the syllable structure, giving some explanations. We have given phonological reasons for the triggering of epenthesis, apocope, and compensatory lengthening, and have proposed that what prompts syncope is perhaps phonetic.

We have also observed how these processes interact with the morphological processes of prefixation, suffixation, reduplication, and compounding. We have a good sense of the behavior of the syllable in prefixation and suffixation. We still have more work to do on in order to fully explain all of the reduplicative and compounded forms.

Through its manifestation of apocope and compensatory lengthening, the Yapese data help to clarify the environments of application and the precise functioning of these processes. It also provides a good example of extrametricality. As well, Itô's proposal for epenthesis is supported by Yapese. In viewing the Yapese phenomena, we obtain a clearer picture of how these processes behave and interact.

References

Clements, G. N. and S. J. Keyser (1983) *CV Phonology: A Generative Theory of the Syllable*. Cambridge, Mass.: MIT Press.

Cohn, A. (1989) "Stress in Indonesian and Bracketing Paradoxes." *Natural Language and Linguistic Theory* 7: 167-216.

Hale, K. (1973) "Deep-surface Canonical Disparities in Relation to Analysis and Change: an Australian Example." *Current Trends in Linguistics* 11: 401-458.

Halle, M. and J. R. Vergnaud (1987) *An Essay on Stress*. Cambridge, MA: MIT Press.

Hammond, M. (1986) "The Obligatory-Branching Parameter in Metrical; Theory." *Natural Language and Linguistic Theory* 4: 185-228.

Hayes, B. (1981) *A Metrical Theory of Stress Rules*. Revised. Ph.D. diss. MIT.

Hayes, B. (1982) "Extrametricality and English Stress." *Linguistic Inquiry* 13: 227-276.

Hayes, B. (1989) "Compensatory Lengthening in Moraic Phonology." *Linguistic Inquiry* 20.2: 253-306.

Hung, H. J. (1990) "[ATR] Harmony in Yapese." ms. Brandeis University.

Itô, J. (1986) *Syllable Theory in Prosodic Phonology*. Ph.D. diss. UMASS, Amherst.

Itô. J. (1989) "A Prosodic Theory of Epenthesis." *Natural Language and Linguistic Theory* 7: 217-257.

Jensen, J. T. (1977) *Yapese-English Dictionary*. Honolulu: University of Hawaii Press.

Jensen, J. T. (1977) *Yapese Reference Grammar*. Honolulu: University of Hawaii Press.

Kaye, J. D. (1990) "'Coda' Licensing." *Phonology* 7: 301-330.

McCarthy, J. J. and A. S. Prince (1990) "Foot and Word in Prosodic Morphology: the Arabic Broken Plurals." *Natural Language and Linguistic Theory* 8.2: 209-283.

Piggott, G. L. (1983) "Extrametricality and Ojibwa Stress." *McGill Working Papers in Linguistics* 1: 80-117.

Piggott, G. L. (1991a) "Apocope and the Licensing of Empty-Headed Syllables." *Linguistic Review* 8: 287-318.

Piggott, G. L. (1991b) Personal Communications.

Piggott, G. L. and R. Singh (1985) "The Phonology of Epenthetic Segments". CJL/RCL 30(4).

Prince, A. S. (1983) "Relating to the Grid." *Linguistic Inquiry* 14: 19-100.

Rehg, K. L. and D. G. Sohl (1981) *Ponapean Reference Grammar*. Pali Language Texts: Micronesia, Ed. D. M. Topping. Honolulu: The University Press of Hawaii.

Steriade, D. (1982) *Greek Prosodies and the Nature of Syllabification*. Ph.D. diss. MIT.